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A taxonomic revision of the Western Palaearctic genus *Cacochroa* Heinemann, 1870 (Lepidoptera, Depressariidae, Cryptolechiinae) with description of a new genus and a new species

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Abstract

Following the description of *Cacochroa rosetella* Corley, 2018 it soon became clear that there was considerable confusion regarding the identity of *Cacochroa permixtella* (Herrich-Schäffer, 1854). In this paper the genus *Cacochroa* is revised and this confusion is resolved, a neotype is chosen for *C. permixtella* and nearly all records verified. Male and female genitalia of *C. permixtella* are remarkably different from those of the remaining species, which are here placed in *Rosetea* Corley & Ferreira, **gen. nov**. The distributions of the three species previously described in *Cacochroa* are clarified. *Cacochroa permixtella* has a distribution limited to Macedonia, Bulgaria, Greece and Turkey. *Rosetea corfuella* (Lvovsky, 2000), **comb. nov.**, is recorded for the first time from Crete, Croatia, Macedonia, Turkey and Israel; the male of *R. rosetella* (Corley, 2018), **comb. nov.**, is described for the first time and the species is recorded for the first time from Spain, France (mainland and Corsica), Italy (mainland and Sardinia), Greece (mainland and Crete), Croatia and Algeria. *Rosetea sara* **sp. nov.** is described from North Africa (Morocco and Tunisia). Male and female genitalia and DNA barcode data are presented for all four species.

Key Words: DNA barcoding, *Rosetea* gen. nov., *Rosetea sara* sp. nov., cytochrome c oxidase I (COI)

Introduction

Cacochroa rosetella Corley, 2018 was recently described from Portugal (Corley, 2018) based on a single female. The genitalia of the new species were compared with the somewhat similar *C. corfuella* Lvovsky, 2000, but female genitalia of *C. permixtella* (Herrich-Schäffer, 1854) as figured in several works (see below) were clearly distinct. After the paper was published it was sent to a number of European microlepidopterists. In response Jacques Nel informed M.C. that there was a puzzle regarding the presence of *C. permixtella* in France. He pointed out that females from France had genitalia matching those of *C. rosetella*, but that males had genitalia resembling those illustrated for *C. permixtella* in Lvovsky (1981).

The genitalia of both sexes of *C. permixtella* were also figured in Tokár *et. al*. (2005), using the same drawings by Lvovsky as were used in Lvovsky (1981) but in the later work the origin of the specimens used is given as 'Südfrankreich, GU AL coll. ZIAN' (male) and 'Türkei, Bursa [Brussa], GU 13903 AL, coll. ZIAN' (female). These were picked from the available specimens in ZIAN (Lvovsky, pers. comm.), the male labelled 'N 436, Gall[ia] m[eridionalis], Staud[inger], [18]66' and the female 'Brussa, Mn [Mann]. 7.51 [1851], coll. Wocke'. The collection has four other females with the same data and two other males, one simply labelled 'N438', the other 'Cannes, Gal[lia] m[eridionalis], N 47'.

It is unlikely that there are two species in France of which one is only represented in collections by males, the other only by females. We hypothesise that there is only one species in France, and that Lvovsky's female from Turkey is *permixtella* but his drawing of the male from France is actually that of the unknown male of *C. rosetella*. The genitalia of *Cacochroa permixtella* are also figured by Hannemann (1997) but his drawings show the same male and female genitalia as in Lvovsky (1981). This problem has passed unnoticed until now mainly because *C. permixtella*

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is a distinctive species with somewhat unusual wing-shape and for this reason genitalia have not been considered necessary for its identification. If this interpretation is correct, then it is necessary to illustrate the male genitalia of *C. permixtella*. On the other hand, if this interpretation is wrong, and Lvovsky's male is the true *permixtella*, then *C. rosetella* becomes a synonym of *C. permixtella* and the female '*permixtella*' belongs to an unrecognised species. This conundrum can only be resolved by reference to type material.

In the present work we aim to resolve these problems by providing a full revision of the genus *Cacochroa* based on morphological and molecular information.

Material and Methods

Specimens have been examined from a number of museums and private collections, together with some specimens donated to M.C. Details of specimens examined are given below under individual species information. This work has been greatly facilitated by photographs of moths and genitalia preparations sent to M.C. by several lepidopterists which have enhanced knowledge of the detailed distribution of each species. We have not personally examined every specimen quoted under 'Material examined'. Some specimens were named by experienced lepidopterists based on information from M.C. on the genitalia differences (indicated in 'Material examined'), and in most cases genitalia photographs have been seen by M.C.

Abbreviations

AL—Alexander Lvovsky (Russia)
ECKU—Collection of Ecology Centre, Kiel University (Germany)
FRRC—Research collection of Frédéric Rymarczyk (France)
GBRC—Research collection of Giorgio Baldizzone (Italy)
GP and gen. prep.—Genitalia preparation
GU—Genitalische Untersuchung [Genitalia preparation]
IBRC—Research collection of Ian Barton (United Kingdom)
INV—Reference number for invertebrate sample in InBIO Barcoding Initiative, Portugal
IRRC—Research collection of Ignác Richter (Czech Republic)
JJRC—Research collection of Jari Junnilainen (Finland)
MCRC—Research collection of Martin Corley (United Kingdom)
MNHU—Museum für Naturkunde, Humboldt-Universität zu Berlin, Germany
MZH—Finnish Museum of Natural History, Helsinki, Finland
NHMUK—Natural History Museum, London, United Kingdom
NHMV—Natural History Museum, Vienna, Austria
NMPC—Národní Muzeum Prague, Czech Republic
SKYVA—Research collection of Jan Skyva (Czech Republic)
TVRC—Research collection of Thierry Varenne (France)
USNM—National Museum of Natural History, Smithsonian Institution, Washington, DC, USA
ZIAN—Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia
ZMUC—Zoological Museum, University of Copenhagen, Denmark
ZSM—Zoologische Staatssammlung München, Germany
ZTRC—Research collection of Zdenko Tokár (Slovakia)

DNA extraction and sequencing. Specimens of each species were selected for DNA barcoding (Table 1). Genomic DNA was extracted from leg tissue using QIAamp DNA Micro Kit (Citomed, Lisboa, Portugal) following manufacturer's protocol, except for the lysis period which was extended to enhance extraction success. The cytochrome c oxidase I (COI) barcoding fragment was amplified using primers LepF and LepR (Hebert et al., 2004). PCR reactions had 10 μL of final volume, containing 5 μL of Multiplex PCR Master Mix (QIAGEN, Hilden, Germany), 0.4μM of each primer, and 1-2μL of DNA. PCR amplification was carried out on a T100 Thermal Cycler (BioRad, Hercules, CA, USA) using the following conditions: initial denaturation at 95ºC for 15 min; 5 cycles at 95ºC for 30 s, 47ºC for 45 s, 72ºC for 45 s; then 40 cycles at 95ºC for 30 s, 51ºC for 45 s, 72ºC for 45 s; and a final elongation

step at 60ºC for 10 min. Chromatograms were checked using Geneious v.10.2.3 (http://www.geneious.com/) and aligned using MUSCLE (with 10 as the maximum number of iterations (Edgar, 2004), and alignments trimmed and corrected manually when necessary). The sequence obtained was blasted against GenBank and BOLD databases.

Phylogenetic analyses. Sequences available in BOLD for three species of *Depressaria* (i.e. *D. cinderella* Corley, 2002, *D. marcella* Rebel, 1901 and *D. krasnowodskella* Hannemann, 1953), *Agonopterix scopariella* (Heinemann, 1870) and two species of *Sorhagenia* (*S. rhamniella* (Zeller, 1839) and *S. nimbosa* (Braun, 1915)) were used as outgroups. The best-fitting model of sequence evolution was determined using jModeltest v.2.1.10 (Darriba et al. 2012) under the Akaike Information Criterion (AIC). Haplotype alignments were analysed using Maximum Likelihood (ML) method. ML trees were built in PhyML (Guindon et al., 2010) with 1,000 bootstrap replicates and searching for the best-scoring ML tree. The average divergence (uncorrected p-distance) between species was calculated in MEGA v.7.0.26 (Kumar et al. 2016) for the COI sequence data.

TABLE 1. Specimens of *Cacochroa* and *Rosetea* sequenced. [Code = InBIO Barcoding Initiative sample code; Date = date of collection; Locality = collecting locality; Lat = latitude; Long = longitude (WGS84 datum, decimal degrees); BOLD = BOLD code for cytochrome c oxidase I (COI)].

Taxa	Code	Date	Country	Locality	Lat	Long	BOLD
C. permixtella	INV05868	31/07/2012	Bulgaria	15 km N Sandanski, Ilindentsi	41.648	23.093	IBILP1319-19
C. permixtella	INV05875	29/04/2004	Greece	Evros, Avandas Gorge	41.069	25.479	IBILP1320-19
R. corfuella	INV05854	10/06/2009	Greece	Lesvos, Keramia	39.125	26.141	IBILP1318-19
R. corfuella	INV05876	06/06/2012	Greece	Samos, Manutates	37.725	26.678	IBILP1321-19
R. corfuella	INV08382	21/06/2011	Greece	Crete, Pánormos 4 km W	35.418	24.684	IBILP1325-19
R. rosetella	INV00778	18/07/2015	Portugal	2 km East of Ansião	39.917	-8.413	IBILP1317-19
R. rosetella	INV05877	15/06/2005	France	Provence, Domaine de Maure Vieille	43.52	6.916	IBILP1322-19
R. rosetella	INV08385	14/08/2016	Italy	Sardinia: Oasi WWF Scivu	39.499	8.343	IBILP1326-19
R. rosetella	INV08386	14/08/2016	Italy	Sardinia: Oasi WWF Scivu	39.499	8.343	IBILP1327-19
R. sara	INV05879	30/05/2015	Morocco	High Atlas, Ourika Valley	31.214	-8.073	IBILP1323-19
R. sara	INV05880	05/05/1988	Tunisia	Ain Draham area	36.774	8.677	IBILP1324-19

Recognition of a new genus

Based on male and female genitalia, *Cacochroa sensu lato* includes four species, which fall into two markedly differing groups, here treated as genera. *Cacochroa sensu stricto* has a single species, *C. permixtella*. The remaining three species are placed in a new genus *Rosetea*. Externally and in wing venation the two genera are extremely similar, but the differences in genitalia are so remarkable (Figs 2–4) that retention in a single genus is impractical. An attempt to define *Cacochroa sensu lato* using male genitalia characters was made, but was meaningless as the two genera as defined here share little more than fundamental characters such as presence of tegumen, valvae, vinculum and aedeagus.

Cacochroa Heinemann, 1870

(Figs 1A-B, 2, 4A)

Cacochroa Heinemann, 1870: 367. Type species *Anchinia permixtella* Herrich-Schäffer, 1854 by monotypy.
Cacophyia Rebel, 1901: 175. An unnecessary objective replacement name for *Cacochroa* Heinemann, 1870, which is not a junior homonym of *Cacochroea* Lederer, 1859 (Lepidoptera: Tortricidae) (Nye & Fletcher, 1991: 51).

Description. Head with smooth scales. Labial palpus slightly curved upwards, segment 2 curved near base, thickened with slightly projecting scales on ventral side, segment 3 one-third length of segment 2, acute. Antenna three-quarters length of forewing, scape without pecten, flagellum ringed with darker intersegmental divisions. Forewing elongate, with markedly convex costal margin, widest at about two-fifths, apex narrower, termen very oblique, tornal angle not evident. Hindwing about three-quarters width of forewing. Forewing with black scales slightly raised.

Male genitalia (Fig. 2). Uncus truncate, with broad median notch, valva with costal portion simple, parallel-sided, half as long as vinculum-saccus, rounded at apex, ventral portion broad with quadrate median process; juxta lobes small, unequal; vinculum broadly ovate, extending into long parallel-sided saccus with subacute apex, the combined vinculum-saccus massive; aedeagus slender, longer than entire genitalia armature, base reflexed; a single long cornutus.

Female genitalia (Fig. 4A). Posterior apophysis twice as long as anterior apophysis; segment VIII with broad rounded lobe on anterior ventral margin; ostium an inverted V; antrum broad, obliquely truncate at anterior end; ductus bursae membranous, with a sclerotised section before the corpus bursae, ductus spermathecae attached at posterior end of corpus bursae, which is flask-shaped; signum stout, in form of an X, but twisted at the middle so that it appears Y-shaped from some angles.

The massive vinculum-saccus is most unusual in the Gelechioidea and is reminiscent of the genitalia of Adeloidea. The valvae are attached in such a way that opening them in the conventional position is not practicable, which makes detailed examination of the structure unsatisfactory.

Cacochroa permixtella (Herrich-Schäffer, 1854)

(Figs. 1A–B, 2, 4A)

Anchinia permixtella Herrich-Schäffer ([1854]): 143. Pl. 79, fig. 599.
Cacochroa permixtella (female) *sensu* Lvovsky, 1981: 575, fig. 4.

Material examined: Neotype female: **'**Mann │ 1863 │Brussa' 'Neotypus│MV 19571 female' (NHMV) **here designated**.

Turkey: Brussa [now Bursa], 1851, Mann leg., 1 ♂, 2 ♀, (NHMV); Brussa, 7.1851, Mann leg., 5 ♀, coll. Wocke (ZIAN); Brussa, 1863, Mann leg., 4 specimens (NHMV); Brussa, 1863, 2 specimens in Stainton coll., 1 in Frey coll. and 2 in Zeller coll. (NHMUK).

Prov. Konya, Seytan Dašlari, 1400 m, 2 km N of Gencek, 2.ix.1983, Werner Wolf leg., 1 ♂, det. J. Šumpich, gen. prep. 18672 (ECKU).

Prov. Ankara, 20 km NW Kizilcahamam, 1200m 24.vii.1986, M. Fibiger leg., 1 ♂, Corley gen. prep. 5382 (ZMUC).

Kayseri, 21 km S, 2200m, Erciyas Dagi, 29.vii.1989, Fibiger & Esser leg., 1 ♀, Corley gen. prep. 5377 (ZMUC).

Prov. Nevsehir, 10 km. V. Ürgüp, 1300m, 30.vii.1996, K.E. Stovgaard leg. (ZMUC).

Greece: Evros, Avandas Gorge, 29.iv.2004, B. Skule leg., 1 ♀, Corley gen. prep. 5654 (ZMUC). DNA barcode: INV05875.

Bulgaria: 15 km N Sandanski, Ilindentsi, 500m, 31.vii.2012, O. Karsholt leg., 1 ♀, Corley gen. prep. 5373 (ZMUC). DNA barcode: INV05868.

Pirin, Sandanski, Ilindentsi, 500 m, 31.vii.-9.viii.2012, N. Savenkov leg., 1 ♂, J. Šumpich gen. prep. 18670(ECKU); same data but 900 m, 1–8.viii.2012, 2 ♀, J. Šumpich gen. prep. 18675; Pirin, Sandanski, Ploski, 200 m, 30.vii.–9.viii.2012, N. Savenkov leg., 8 ♂, 7 ♀, J. Šumpich gen. prep. 18673 and 18674 (ECKU).

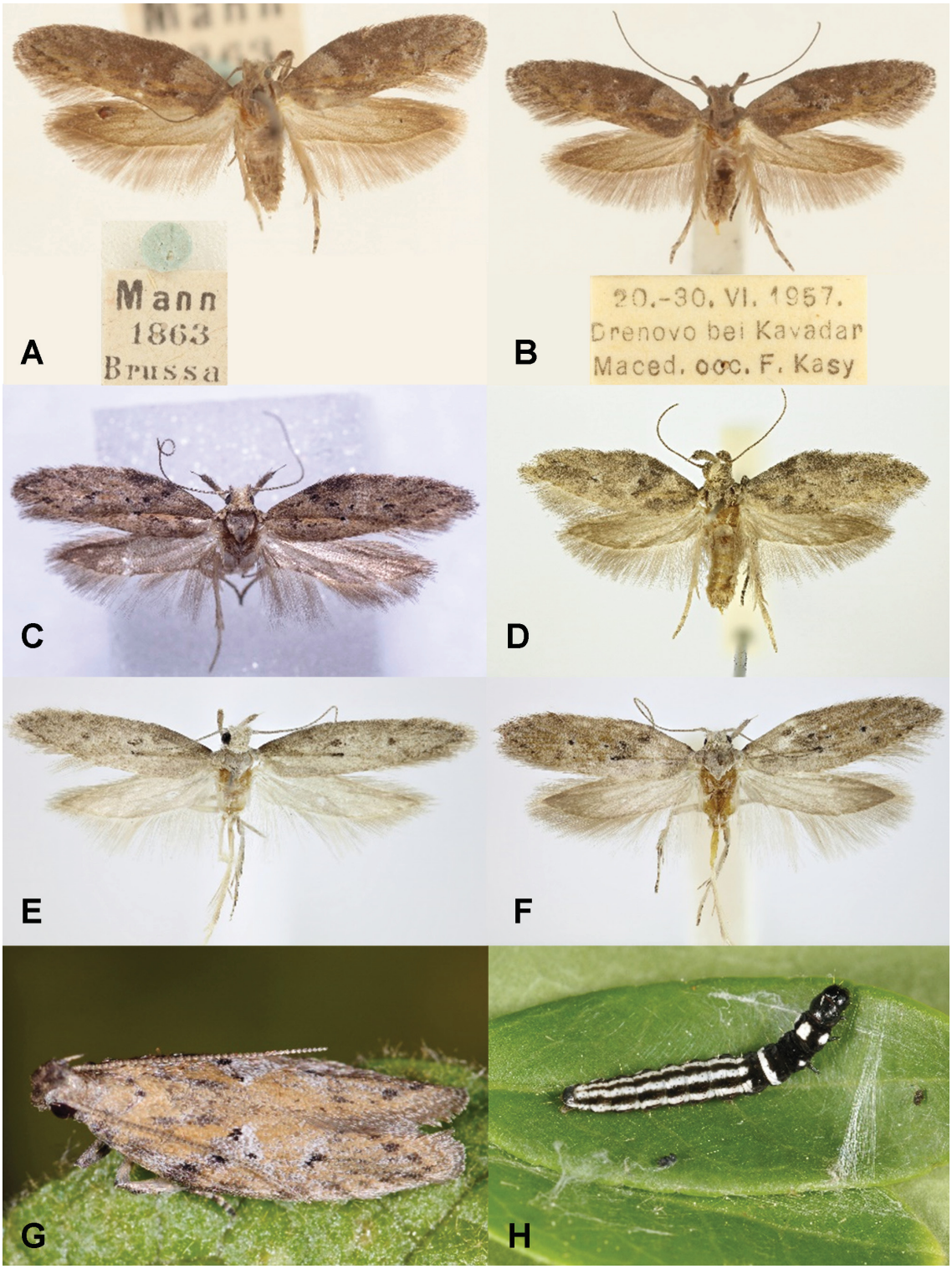

FIGURE 1. A. *Cacochroa permixtella* (H.-S.) ♀, neotype, Turkey, Brussa, 1863, Mann. leg. (NHMV). **B.** *Cacochroa permixtella* (H.-S.) ♀, Macedonia, Drenova, Kavadar, 10−30.vi.1957, F. Kasy leg. (NHMV). **C.** *Rosetea rosetella* (Corley), ♀, holotype, Portugal, Leiria, 2 km east of Ansião, 18.vii.2015, J. Rosete leg. (NHMUK). **D.** *Rosetea corfuella* (Lvovsky), ♀, Croatia, Dalmatia, Pelješac, Žuljana, 1−13.vii.2005, J. Šumpich leg. (NMPC). **E.** *Rosetea sara* sp. n., ♂, holotype, Morocco, High Atlas, Ouirgane, 10 km NW, 30.v.−3.vi.2015, C. Hviid, O. Karsholt & K. Larsen leg. (ZMUC). **F.** *Rosetea sara* sp. n., ♀, paratype, Tunisia, Ain Draham area, 5−18.v.1988, O. Karsholt leg. (ZMUC). **G.** *Rosetea rosetella*, adult in resting position reared from larva, France, Alpes Maritimes, Saint-Vallier-de-Thiéy, 14.vi.2011, F. Rymarczyk. **H.** *Rosetea rosetella* larva on *Phillyrea latifolia*, France, Alpes Maritimes, Saint-Vallier-de-Thiéy, 22.v.2011, F. Rymarczyk.

FIGURE 2. Male genitalia: *Cacochroa permixtella* (H.-S.), Turkey, Brussa, 1851, Mann. leg. (NHMV), P. Buchner gen. prep.; lateral view (on right).

Macedonia: Drenova, Kavadar, leg. F. Kasy, 10-30.vi.1957, 2 specimens (NHMV).

North Macedonia, Pepelište, near Negotino, 24.vi.2017, 1 ♀, leg. and det. Ignác Richter, GP28044 IgR (IRRC).

Typification of *Cacochroa permixtella* (Herrich-Schäffer, 1854)

The species was originally described as *Anchinia permixtella* Herrich-Schäffer, 1854. In an effort to clarify its identity a search for type material was made. Gottlieb August Wilhelm Herrich-Schäffer was a German physician and entomologist who lived in Regensburg. His Microlepidoptera are known to be present in several institutions including MNHU, ZSM and NHMUK but enquiries indicated that none of these had possible type material, although there were specimens of *C. permixtella* in NHMUK in the collections of other lepidopterists of the 1850s. NHMV was also investigated but had no specimens with any evident connection to Herrich-Schäffer but it does have specimens collected by Mann in 1851 and 1863 from Brussa (now Bursa) in Turkey.

In Herrich-Schäffer's (1854) description of *Anchinia permixtella* the species name is followed by 'Metzn.' and following the description the distribution given is 'Aus der Wienergegend' [From the Vienna district]. There is no mention of Mann.

'Metzn.' refers to Alois Metzner. He was a collector who lived at Frankfurt an der Oder, Germany, and died in 1861. According to Nye & Fletcher (1991: 51) *Anchinia permixtella* was a Metzner manuscript name made nomenclaturally available by Herrich-Schäffer. Ole Karsholt (pers. comm.) has suggested a different interpretation. It was

common practise at that time for informal names to be used within the European microlepidopterists community for undescribed species. Thus *Anchinia permixtella* was indeed described by Herrich-Schäffer, but he referred to the species that had already acquired its name from Metzner. Which interpretation is correct is open to conjecture but it should be noted that Herrich-Schäffer does not mention Mann for this species although he does in other instances (e.g. *Carposina berberidella* Herrich-Schäffer, 1854). This together with the absence of type material of *C. permixtella* would suggest that he simply published a description written by Metzner.

Josef Mann was a Viennese entomologist and dealer who collected in southern Europe, mainly on either side of the Adriatic Sea, but in some years travelled as far as Turkey. His first expedition in 1846 was to Tuscany. New species from this expedition were described by Philipp Christoph Zeller (Zeller, 1850) and Zeller continued to describe new species from Mann's subsequent expeditions. Metzner had been Zeller's informal tutor in entomology at Frankfurt an der Oder. For a time, Zeller was a primary school teacher at Glogau (now Głogów in Poland), but later he taught in a secondary school in Frankfurt an der Oder. Zeller and Metzner were both in Frankfurt between 1851 when Mann travelled to Turkey and 1854 when Herrich-Schäffer published the description of *A. permixtella.* Thus it appears possible that Metzner had access to Mann's material through Zeller. Mann's 1851 material was also available to other lepidopterists of that era since specimens are present not only in NHMV but also in the Wocke collection in ZIAN and there are specimens collected by Mann in 1863 in the collections of Frey, Zeller and Stainton in NHMUK.

In order to resolve the confusion that has arisen as to the identity of *A. permixtella*, with figured male and female genitalia belonging to different species, a type specimen is needed. Herrich-Schäffer did not designate a holotype, nor have searches in institutions that are known to possess Herrich-Schäffer material produced any type material. This leaves the options of designating a lectotype or a neotype. As far as we are aware the only specimens of *permixtella* available in 1854 were those collected by Mann in Turkey in 1851. Since there is only circumstantial evidence that Herrich-Schäffer was referring to Mann's specimens, it is not appropriate to choose one of these as lectotype. This leaves only the option of choosing a neotype for *Anchinia permixtella* Herrich-Schäffer, 1854.

ICZN (1999) Rule 75 lays down strict conditions for designating a neotype. A neotype is necessary to clarify the status and type locality of *A. permixtella*, both of which are confused and because no other type material exists. According to ICZN (1999) Rule 75.3.6 a neotype should be chosen from as near the original locality as possible. That locality, 'Aus der Wienergegend' is puzzling. The species has never been recorded again from Austria (Peter Huemer, pers. comm.), although it remains in the Austrian checklist (Huemer 2013). The nearest known localities for any *Cacochroa* are on the coast of Croatia. Without evidence to the contrary we regard the original location given as erroneous. Both *Cacochroa rosetella* and *C. corfuella* occur on the coast of Croatia but *C. rosetella* at Biograd is nearest to Vienna. If a specimen of *C. rosetella* were chosen as neotype of *C. permixtella*, then *C. rosetella* would become a junior synonym of *C. permixtella*, leaving the species collected by Mann in Turkey without a name. A similar problem would occur if a specimen of *C. corfuella* was chosen. It is also appropriate to consider what material was available to lepidopterists at the time of the description of *A. permixtella*. There were a number of specimens of *permixtella* collected in Turkey by Mann in 1851. The earliest collected specimens of the species treated in this paper as *C. rosetella* were collected by Staudinger in south France in 1866 (specimen in ZIAN). *C. corfuella* was not collected until 1978. From this it follows that the original 1854 concept of *Anchinia permixtella* did not include more than one species. Complications only arose later when material of *C. rosetella* was also referred to *C. permixtella*. Therefore, to avoid unnecessary nomenclatural complications we hereby choose as neotype a female collected by Mann at Brussa, Turkey in 1863 which is in the collection of NHMV. It has the label `Neotypus MV 19571 female'. An 1863 specimen has been chosen, rather than one from 1851 because it is in better condition. The neotype is chosen in order to stabilise the use of the name *permixtella* Herrich-Schäffer, 1854. Lvovsky (1981) figured female genitalia of a specimen from Brussa as *permixtella*, so this choice of a female neotype preserves the accepted use of the names of both *permixtella* and *rosetella* and in consequence allows the name *rosetella* to be used for the misidentified male figured by Lvovsky (1981) as *permixtella*. This untangles the confusion implicit in Jacques Nel's observation that *Cacochroa* in France has females with the genitalia of the Portuguese holotype of *rosetella* and males with genitalia as figured for *permixtella* by Lvovsky (1981), since these males can now be attributed to *rosetella*.

Description and diagnosis of the chosen neotype follows below. A consequence of this designation of a neotype is that the male of *permixtella* is undescribed. There is also considerable uncertainty regarding the true distribution of this species and of *rosetella*.

Diagnosis. Externally *C. permixtella* resembles *Rosetea* species, but differs fundamentally in genitalia. In the male the extraordinary development of the vinculum-saccus and the structure of the valva very clearly separates it from all *Rosetea* species. In the female the absence of a setose flap adjacent to the ostium and the shape of the signum are differentiating characters.

Description (Figs. 1A–B). Wingspan 13−15 mm. Face creamy white, vertex grey; labial palpus segment 3 one-third length of segment 2, segment 2 whitish buff on inner side, grey on outer side, overlaid fuscous towards apex, segment 3 whitish buff, basal part dark fuscous, apex black; antenna grey, ringed dark fuscous, each segment with a fuscous spot on upper side. Thorax grey. Forewing ochreous, almost entirely overlaid dark grey, fold ochreous; basal quarter in costal half paler than rest of wing; raised black scales forming 3-5 dots or spots in disc from one-third to one-half; a series of blackish dots between veins along termen; fringe grey. Hindwing grey to dark grey.

Male and female genitalia: see description of genus, above (Figs. 2, 4A).

Biology. Adults have been taken from close to sea-level up to 2200 m, in late April, in June and from end of July to early September. While this suggests the possibility of two or even three generations, there is only one April record and two from June. The larva and host-plant of *permixtella* are unknown. All published records of larvae previously referred to this species actually belong to *Rosetea rosetella*.

Distribution (Fig. 5). Macedonia, Bulgaria, Greece (Thrace) and Turkey. Records given for this species in Fauna Europaea (Lvovsky, 2011) for Spain, mainland France, Corsica, mainland Italy, Sardinia and Crete belong to other species. The record for Austria is treated as erroneous.

Rosetea Corley & Ferreira gen. nov.

Type species *Cacochroa rosetella* Corley, 2018, by present designation.

Description. Externally resembling *Cacochroa* but segment 3 of labial palpus one-third to one-half length of segment 2; black scales on forewing not raised. In *R. sara* sp. nov. the forewing is only weakly convex.

Male genitalia (Figs 3A–D). Uncus and gnathos absent; tegumen low, rounded; valva broad, expanding from base, costal margin with broad-based digitate process curving outwards, terminal margin with sclerotised hook crossing digitate process then directed outwards, ventral margin extended into a digitate process, inner face with a harpe; juxta with long, pointed, sclerotised, unequal processes, the left longer than the right; vinculum-saccus broad, without anterior extension; aedeagus with or without reflexed base, cornuti various.

Female genitalia (Figs 4B–D). Posterior apophysis 2 to 4 times as long as anterior apophysis; segment VIII with nearly straight anterior ventral margin; ostium at anterior edge of segment VIII, more or less concealed by a broad rounded, bell-shaped or bluntly triangular lobe, associated with a tongue-shaped or quadrate flap with terminal setae; antrum tapering to ductus bursae, variously sclerotised; membranous ductus bursae short, gradually or more abruptly expanding to corpus bursae, ductus spermathecae arising from posterior end of corpus bursae, sometimes from a bulge; signum knife or thorn-like with outer margin serrate.

Etymology. The name *Rosetea* honours the Portuguese lepidopterist Jorge Rosete after whom *R. rosetella* was named.

Rosetea rosetella (Corley, 2018) comb. nov.

(Figs 1C, 1G-H, 3A, 4B)

Cacochroa rosetella Corley, 2018: 76.
Cacochroa permixtella (male) *sensu* Lvovsky, 1981: 575, fig. 3.

Material examined: Portugal: Holotype female, Leiria, 2 km east of Ansião, 18.vii.2015, J. Rosete leg., Corley gen. prep. 4641 (NHMUK). DNA barcode: INV00778.

Spain: Huelva, Moguer, Pino del Cuervo, 10.vi.2003, ex larva *Phillyrea angustifolia*, M. Huertas leg., 2 ♂, 2 ♀, Corley gen. prep. 5363; male and female gen. preps B. Goodey (MCRC).

France: Gall[ia] m[eridionalis], Staud[inger], [18]66 1 ♂(ZIAN).

'Gall. Mer.' [18]86, Constant (NHMV).

'Gall. Mer.' [18]90, Constant (NHMV).

Alpes Maritimes, Golfe Juan, [no date], Constant, 10 specimens (NHMUK).

Alpes Maritimes, Saint-Vallier-de-Thiéy, 14.vi.2011, F. Rymarczyk, ex larva (FRRC).

Cannes, leg. Ragonot, [no date], (NHMV).

Cannes, *Phillyrea latifolia*, 6.vi.1890, em. 26−27.vi.1890, Walsingham leg. (NHMUK); same data but *Phillyrea angustifolia*, em. 25−28.vi.1890.

Provence, Domaine de Maure Vieille, 10.vi.2001, H. Hendriksen leg., 1 ♂(ZMUC); same data but 15.vi.2005, 1 ♀. DNA barcode: INV05877.

Var, Tanneron, leg. T. Varenne, 1 ♀(TVRC).

Corsica, 10 km SE Calvi, Forêt de Bonifatu, 400m, 22.vi.1994, B. Skule & P. Skou leg., 1 ♂, Corley gen. prep. 5378 (ZMUC).

Italy: Liguria, Capo Mele, 8.vii.[19]62, leg. E. Jäckh, ♂ gen. prep. M.A. Metz USNM 141,548 (USNMENT01480144) (USNM).

Sardinia, Tempio di Antas, 30.vii.1974, 1 ♂, G. Baldizzone leg., Baldizzone gen. prep. 16724 (GBRC).

Sardinia, Oasi WWF Monte Arcosu, Su Tragu, 130m, 1.vii.2004, 1♀, G. Baldizzone leg. (GBRC).

Sardinia, Oasi WWF Scivu, 14.viii.2016, 1 ♂, 1 ♀, O. Maioglio leg., Baldizzone female gen. prep. 16726 (GBRC). DNA barcode: ♂- INV08385, ♀- INV08386.

Croatia: Gravosa Aquäd., 12.vi.1928, Knitschke, 1 ♀(NHMV); Gravosa, 4-20.vi.1939, leg. J. Klimesch, ex larva *Phillyrea*, 25.v.1939, 1 ♂, GP M. Dale 02552; Gravosa, 4-30.vi.1939, leg. J. Klimesch, ex larva *Phillyrea*, 25.v.39, GP M. Dale 02553 (ZSM); Biograd, 5−12.vii.2003, J. Šumpich leg. and det., 1 ♀, gen. prep. 18676 (NMPC).

Greece: Litochoron 300−400m, 7-13.vii.1957, leg. J. Klimesch, 1 ♂, GP M. Dale 02558 (ZSM).

Litochoro-Plaka, 28.vi.1997, Z. Tokár leg. & det., 1 ♀, GP13331 ZT (ZTRC).

Mt. Olympus, Litochoron, 350m, 25.vii.1980, 3 ♂, 3 ♀, G. Baldizzone leg., Baldizzone gen. preps 16725, 16729 (GBRC).

Epyrus, str. Metsvovon, 800m, 26.vii.1973, 1♀, G. Baldizzone leg., Baldizzone gen. prep. 16727 (GBRC).

Crete, 4 km S Topolia, 300m, 23−29.vi.2000 leg. M. Fibiger, P. Svendsen, D. Nilsson, A. Madsen, 1 ♂, Corley gen. prep. 5385 (ZMUC).

Algeria: Philippeville [now Skikda], larvae on *Phillyrea latifolia*, 14.v.1904, 7 specimens emerged 5−18.vii.1904, Walsingham leg., M. Dale gen. preps ♂ and ♀(NHMUK).

Diagnosis. *R. rosetella* is distinguished from other *Rosetea* species by the size and shape of the juxta lobes and the absence of a process on the harpe. In the female the long signum separates it from the other two species.

Description (Figs 1C, 1G). Wingspan 12−13 mm. Face creamy white, vertex pale grey mixed light brown. Labial palp slightly recurved, segment 2 thickly scaled, grey-brown, segment 3 half as long as segment 2, slender, pointed, buff with black base and apex. Antenna light grey with narrow light brown rings. Thorax and tegula pale grey mixed light brown. Forewing with costa curved throughout with greatest curvature at two-fifths, apex acute, termen very oblique, tornal angle obsolete; mixed grey and light to mid-brown; blackish spots on costa at one-third and two-fifths, the latter larger, with smaller spots near apex; various black dots, two in fold, two between fold and dorsum, one in cell at one-third, a smaller one just beyond this and one at end of cell, a few forming a dotted line running from small cell dot towards costa at two-thirds; fringe grey-brown. Hindwing narrower than forewing, apex acute, dull grey, darker towards apex; fringe dull grey.

Male genitalia (Fig. 3A). Valva considerably expanded from near base to apex, sclerotised hook at end of costal margin stout, not tapering at middle, process at end of ventral margin broad, harpe a plate ending in a rounded hump on costal side and a broad point on ventral side; juxta lobes stout, extending well beyond posterior end of tegumen; aedeagus with recurved base, with cornuti through much of its length, gradually longer towards apex.

Female genitalia (Fig. 4B). Papilla analis parallel-sided, rounded at apex; posterior apophysis 3.5 times as long as anterior apophysis; ostium partly covered by a broadly triangular plate with obtuse apex and concave sides, associated tongue-shaped flap with terminal setae, antrum conical; ductus bursae narrow, expanding into broadly pyriform corpus bursae; signum long, three-fifths length of posterior apophysis, slightly curved blade-like structure with expanded posterior end, abruptly narrowed to parallel-sided one-third, then expanded to anterior half with one margin serrated, acutely pointed.

Biology. Adults have been taken at light from June to August, mainly at low altitudes, reaching 800 m in Greece.

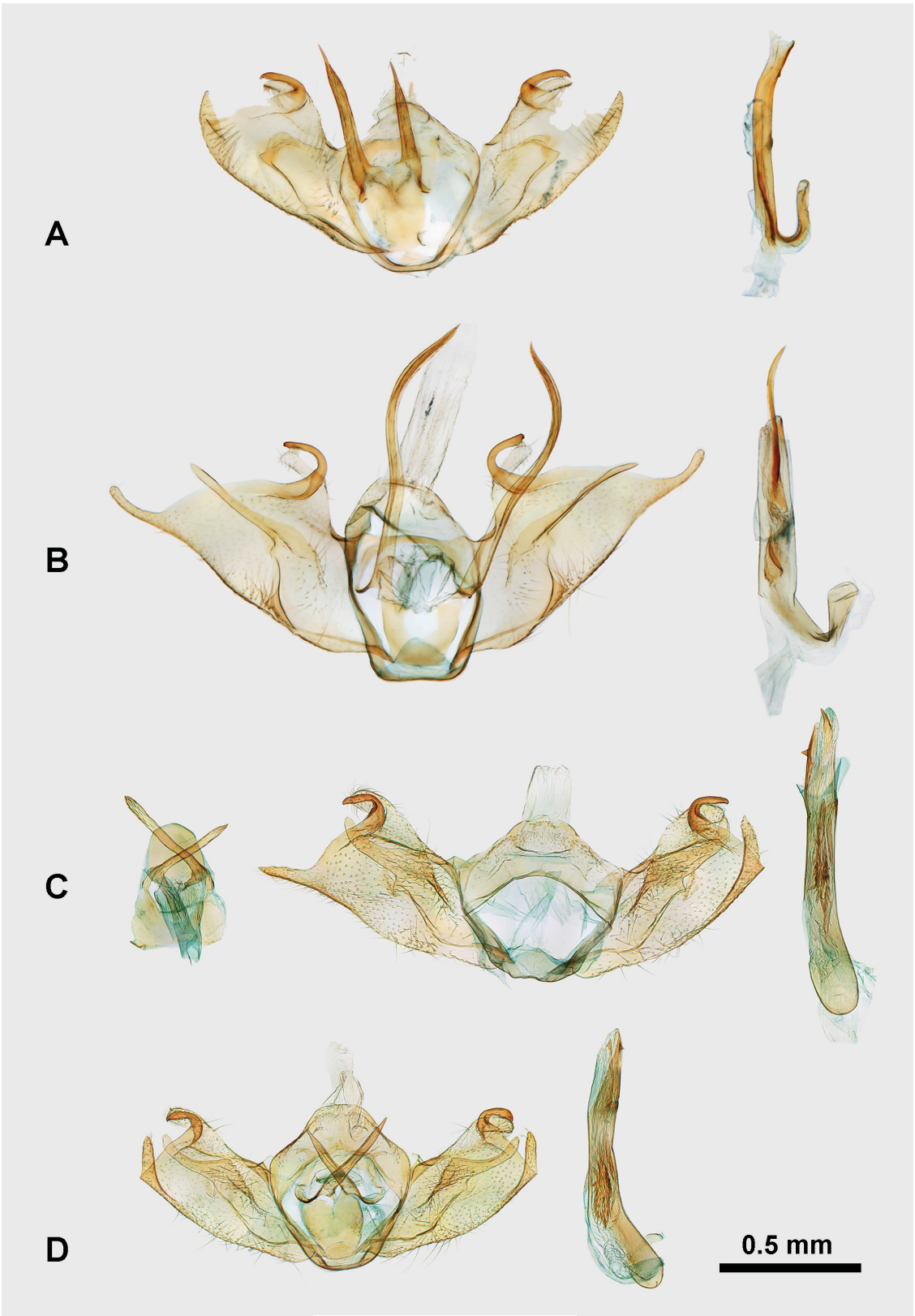

FIGURE 3. Male genitalia: **A.** *Rosetea rosetella* (Corley), Spain, Huelva, Moguer, Pino del Cuervo, 10.vi.2003, ex larva *Phillyrea angustifolia*, M. Huertas leg., (MCRC), B. Goodey gen. prep. **B.** *Rosetea corfuella* (Lvovsky), Greece, Lesvos, Keramia, 10.vi.2009, L. Kaila & J. Kullberg leg., (MCRC), B. Goodey gen. prep. **C.** *Rosetea sara* sp. n., holotype, Morocco, High Atlas, Ouirgane, 10 km NW, 30.v.−3.vi.2015, C. Hviid, O. Karsholt & K. Larsen, (ZMUC), B. Goodey gen. prep. 5405 (juxta extracted to small figure on left). **D.** *Rosetea sara* sp. n., Tunisia, Ain Draham area, 5−18.v.1988, leg. O. Karsholt, (ZMUC), B. Goodey gen. prep. 5406.

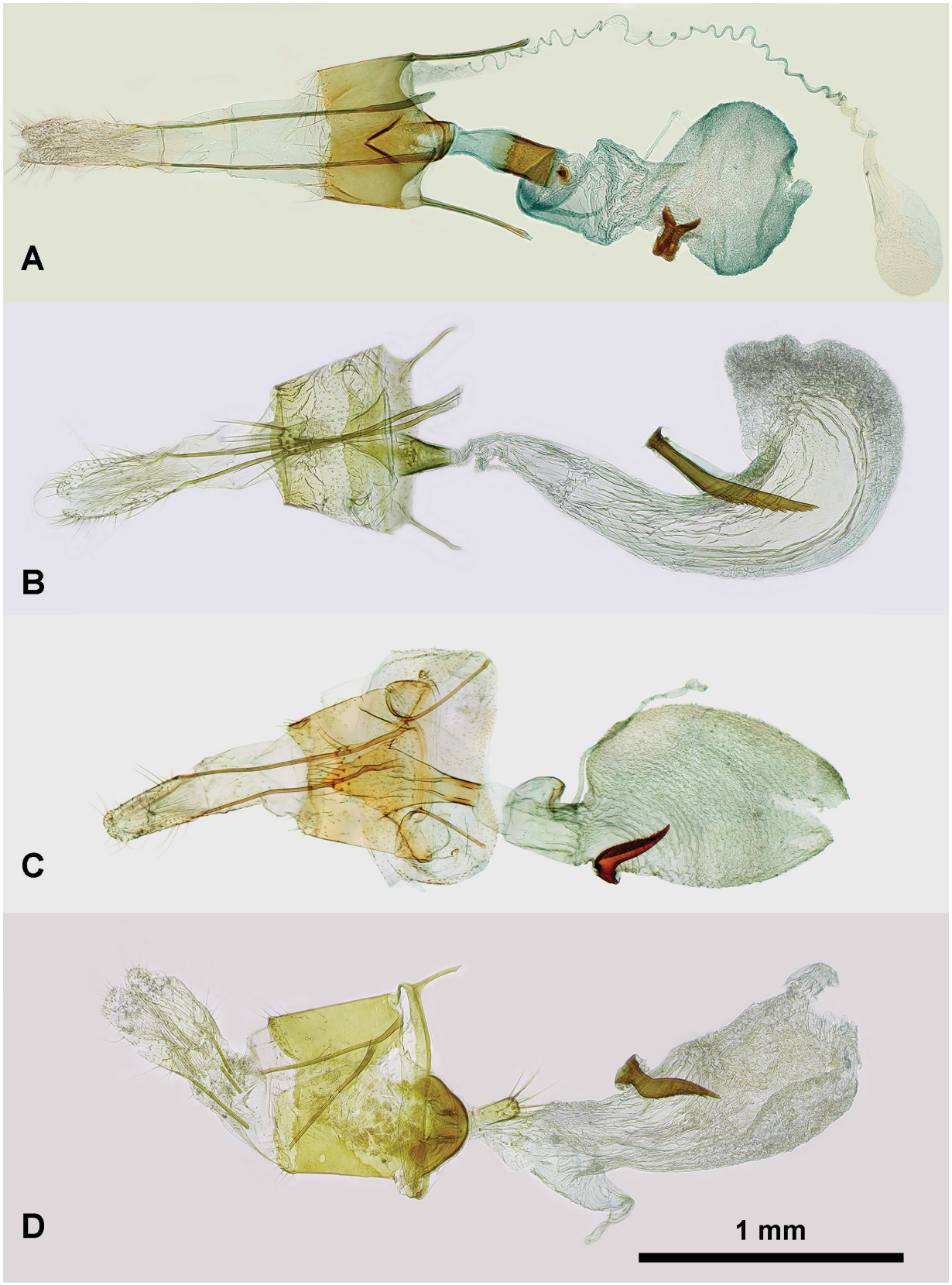

FIGURE 4. Female genitalia: **A.** *Cacochroa permixtella* (H.-S.), Turkey, Brussa, 1851, Mann. leg. (NHMV), gen. prep. P. Buchner. **B.** *Rosetea rosetella* (Corley), Algeria, Philippeville [now Skikda], larvae on *Phillyrea latifolia*, 14.v.1904, Lord Walsingham leg. (NHMUK), M. Dale gen. prep. **C.** *Rosetea corfuella* (Lvovsky), Greece, Lesvos, Keramia, 10.vi.2009, L. Kaila & J. Kullberg leg., in coll. Corley, B. Goodey gen. prep. **D.** *Rosetea sara* sp. n., Tunisia, Ain Draham area, 5−18.v.1988, leg. O. Karsholt, (ZMUC), M. Corley gen. prep. 5374.

Larva (Fig. 1H). *R. rosetella* has been reared from larvae found on *Phillyrea latifolia* L. (sometimes given as *P. media* L.) and *P. angustifolia* L. (Oleaceae) in France by Constant (1890), specimens in NHMV and NHMUK, by Walsingham in 1890, specimens in NHMUK and recently by Rymarczyk (pers. comm.), also from Spain (Huertas, 2003) and Algeria (Walsingham in 1904, specimens in NHMUK). In all cases the species was originally named as *C. permixtella*, but all belong to *R. rosetella*. Walsingham (1901) mentions rearing *C. perplexella* from Morocco (Cape Spartel), but there is no specimen in his collection with this data, so the identification cannot be proved. Initially larvae mine the leaves in short galleries usually with lateral diverticula, later feeding among spun leaves. Larvae are figured by Constant (1890), Huertas (2003) under the name of *C. permixtella* and by Rymarczyk (Pathpiva, 2019) as *C. rosetella*. Hering (1957) figures the leaf mines of *permixtella* but it is not known if adults were reared.

Distribution (Fig. 5). Portugal and Spain (apparently rare), south France, Corsica, north-east Italy, Sardinia, rarer in Eastern Mediterranean, but recorded from Croatia, mainland Greece and Crete; Algeria. A probable record (as *C. permixtella*) from Morocco (Cape Spartel) cannot be confirmed (Walsingham, 1901). *C. permixtella* was recorded from Sardinia, "Fontanamela 30-VII; Mine sulla *Phillyrea variabilis* da Aritzo 30-VI[-1936]; Ricchello raccolse le stesse Cagliari nel III ed a Campuomo, 19-IX" (Hartig & Amsel, 1951). We have not examined this material, but it is likely to be *R. rosetella* as that is the species found elsewhere on Sardinia and also on Corsica.

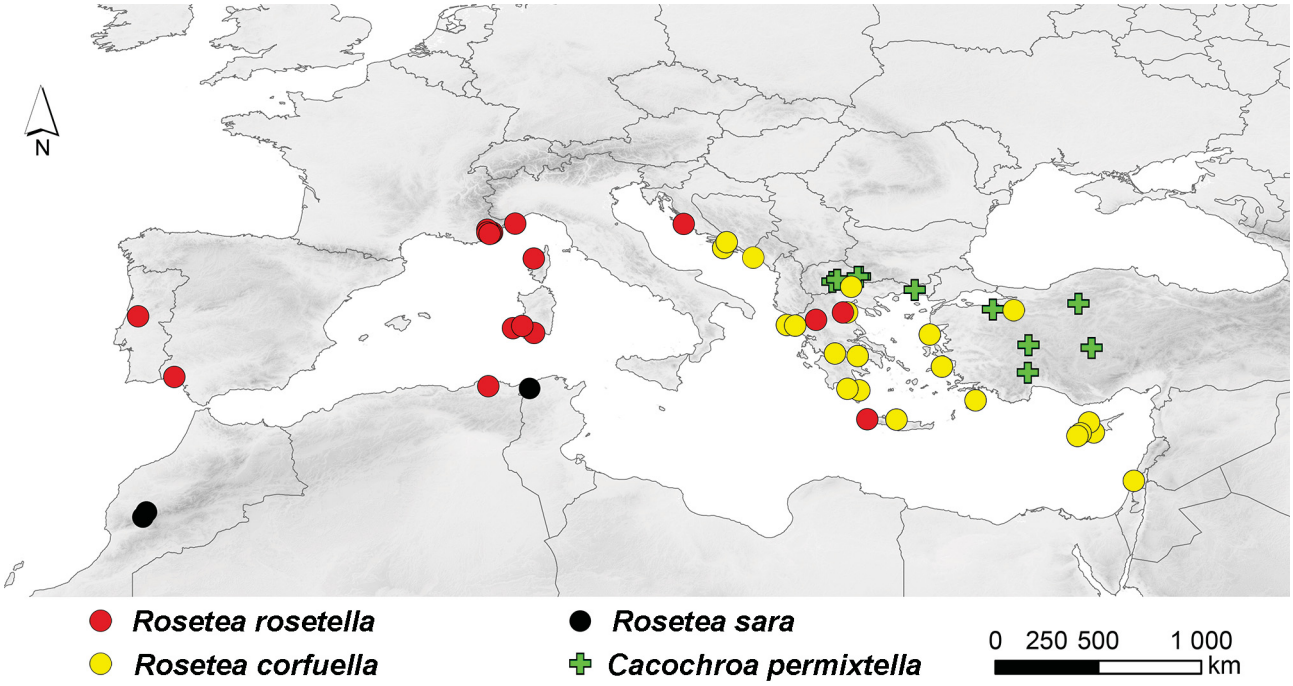

FIGURE 5. Known distribution of the analysed *Cacochroa* and *Rosetea* specimens.

Rosetea corfuella (Lvovsky, 2000) comb. nov.
(Figs 1D, 3B, 4C)

Cacochroa corfuella Lvovsky, 2000: 335.

Material examined:

Greece: Corfu, Benitses, 6−14.vi.1978, Vesa Varis leg., 3 ♂, 4 ♀, [Type series] (MZH, ZIAN).

Litochoron 300−400m, 14-23.vi.1957, leg. J. Klimesch, 1 ♂, GP M. Dale 02558 (ZSM).

Igoumenitsa (5 km W), 5 m, 5.vii.2005, J. Skyva leg., 1 ♀, gen. prep. Šumpich 18284, (SKYVA).

Peloponnes, Lakonia, 5 km S. Monemvasia, 21−30.vii.1982, 1 ♂, 1 ♀, G. Baldizzone leg., Baldizzone gen. prep. 16728 (GBRC).

Lakonia, 10 km. S. Githion, 100m, 30.v.1994, O. Karsholt leg., 1 ♂, (ZMUC).

Peloponnes, Kamares Ano Salmonikas, 450 m, 13.vi.2008, J. Skyva leg., 2 ♂, 1 ♀, gen. preps Šumpich 18282, 18281 (SKYVA),.

Peloponnes, Diakofto, 30 m, 19−25.vi.2001, J. Skyva leg., 1 ♀, gen. prep. Šumpich 18286 (SKYVA).

Peloponnes, Diakofto, 70 m, 19.vi.2011, J. Skyva leg., 3 ♂, gen. prep. Šumpich 18285 (SKYVA).

Lesvos, Keramia, 10.vi.2009, L. Kaila & J. Kullberg leg., 1 ♂, 1 ♀, gen. preps. B. Goodey (MCRC). DNA barcode: INV05854 (♀).

Samos, Manutates, 6.vi.2012 leg. C. Hviid & B. Skule leg., 1 ♀, Corley gen. prep. 5655 (ZMUC). DNA barcode: INV05876.

Rhodos, Faliraki, 1.v.1984, leg. J. Klimesch, 1 ♂ ex larva *Olea europaea*, GP M. Dale 02557 (ZSM); Faliraki, 25.v.1987, leg. J. Klimesch, 1 ♂ex larva *Olea europaea*, GP M. Dale 02555 (ZSM).

Rhodos, Akropolis, 25.v.1984, leg. J. Klimesch, GP M. Dale 02556 (ZSM).

Rhodos, Kolombia, 40 m., 4−5.vii.2000, M. Fibiger leg., 1 ♂, Corley gen. prep. 5387 (ZMUC).

Crete, Pánormos, 4 km W, 21.vi.2011, Z. Tokár leg., 1 ♂, GP ZT No. 13330 (ZTRC). DNA barcode: INV08382; Pánormos, 2.5 km W, 17.vi.2011, Z. Tokár leg., 1 ♂, GP ZT No. 13546 (ZTRC).

Croatia: Dalmatia, Pelješac, Žuljana, 100 m, 1−13.vii.2005, J. Šumpich leg. and det., 1 ♂, 1 ♀, gen. preps 18274, 18273 (NMPC).

Zaostrog – Kosoviči, 8.vii.2004, Z. Tokár, 1 ♂, GP ZT No. 13329 + 2 specimens 9.vii.2004 (ZTRC).

Macedonia: North Macedonia, Gopceli (near Dorjan lake), 31.v.2014, I. Richter leg. and det., 1 ♂, GP28043 IgR (IGRC).

Turkey: Bilecik, 27.v.1964, leg. J. Klimesch, 1 ♂, GP M. Dale 02554 (ZSM).

Cyprus: Kato Drys, 23.iv.2002, J. Junnilainen leg., 4 ♂, (JJRC).

Selvilitepe, 600m, above Kozan, 35.302° N, 33.095° E, 13.v.2007, B. Skule leg., 1 ♀, Corley gen. prep. 5386 (ZMUC).

Kidasi, 26.iv.2017, I. Barton leg., 1 ♂, 27.iv.2017, IB gen. prep. 1615 (IBRC).

Secret Valley, 27.iv.2017, I. Barton leg., IB gen. prep. 1616 (IBRC).

Israel: Nahal Oren, Mt. Carmel, light trap, 21.viii.1998, SFS-1, Pavlíček & Kravchenko leg., det. J. Šumpich, 1 ♀, gen. prep. 18422 (NMPC).

Diagnosis. *R. corfuella* is easily separated from the other *Rosetea* species by the very long juxta lobes, which can be seen without dissection if some scales are brushed away. In the female the short signum is similar to that of *R. sara*, but the two species clearly differ in the structures around the ostium.

Description (Fig. 1D). Wingspan 13−14 mm. Face creamy white, vertex buff, greyer anterolaterally; labial palpus segment 3 one-third length of segment 2, segment 2 inner side whitish buff, outer side grey-buff, light fuscous at base and apex, segment 3 fuscous near base, black-tipped; antenna light grey-buff, intersegmental divisions light fuscous, each segment with light fuscous spot on upper side. Thorax grey-buff, tegulae grey anteriorly. Forewing ochreous-buff heavily overlaid with grey, particularly in costal half; two obliquely placed blackish spots in middle of wing at one-quarter to one-third, lying in a patch of darker grey scales, edged whitish, the first spot closer to costa, a pair of black dots at end of cell, a series of blackish dots between veins along termen; fringe grey. Hindwing light grey to grey-brown.

Male genitalia (Fig. 3B). Valva expanding from base, costal margin much shorter than ventral, ending in a sclerotised hook that is narrower in outer half than basal half, ventral margin ending in long slender process, harpe with long slender process, exceeding posterior margin of valva; juxta lobes quite slender, bent outwards at two-fifths, then evenly curving inwards towards each other; aedeagus with recurved base, some small cornuti and a single long cornutus nearly half as long as aedeagus. The long juxta lobes can be seen by brushing away some scales at the tip of the abdomen in dried specimens.

Female genitalia (Fig. 4C). Posterior apophysis twice as long as anterior apophysis; ostium concealed by a broadly triangular lobe associated with a quadrate process with spinous distal part; antrum triangular, tapering anteriorly to weakly sclerotised colliculum; ductus bursae short, with ductus spermathecae arising from bulge on ductus bursae, corpus bursae elliptic, opening into one edge of base of elliptic corpus bursae; signum a stout thorn, strongly bent at base, with spinous teeth on its outer margin.

Variation. One male from Crete (Pánormos 4 km W, 21.vi.2011, Z. Tokár leg., GP ZT 13330 (ZTRC), DNA barcode: INV08382) has unusually short juxta processes, but DNA barcode places it in *R. corfuella*.

Biology. Adults fly from end of May to July. It has been recorded in April in Cyprus (Barton, 2018) and in late August in Israel, suggesting that it may be double-brooded in some areas. Mainly in lowlands, but reaching 600 m in Cyprus. Larvae have been found on olive (*Olea europaea* L.) on Rhodos. *Olea* is in the same family (Oleaceae) as *Phillyrea*. No description of the larva exists, but Klimesch reared both this species and *R. rosetella* without ques-

tioning their identity, in spite of the different host-plants, from which it can be concluded that the larvae of the two species appear similar.

Distribution. (Fig. 5) Croatia, Macedonia, Greece including Crete and islands close to Turkish coast, Turkey, Cyprus, Israel.

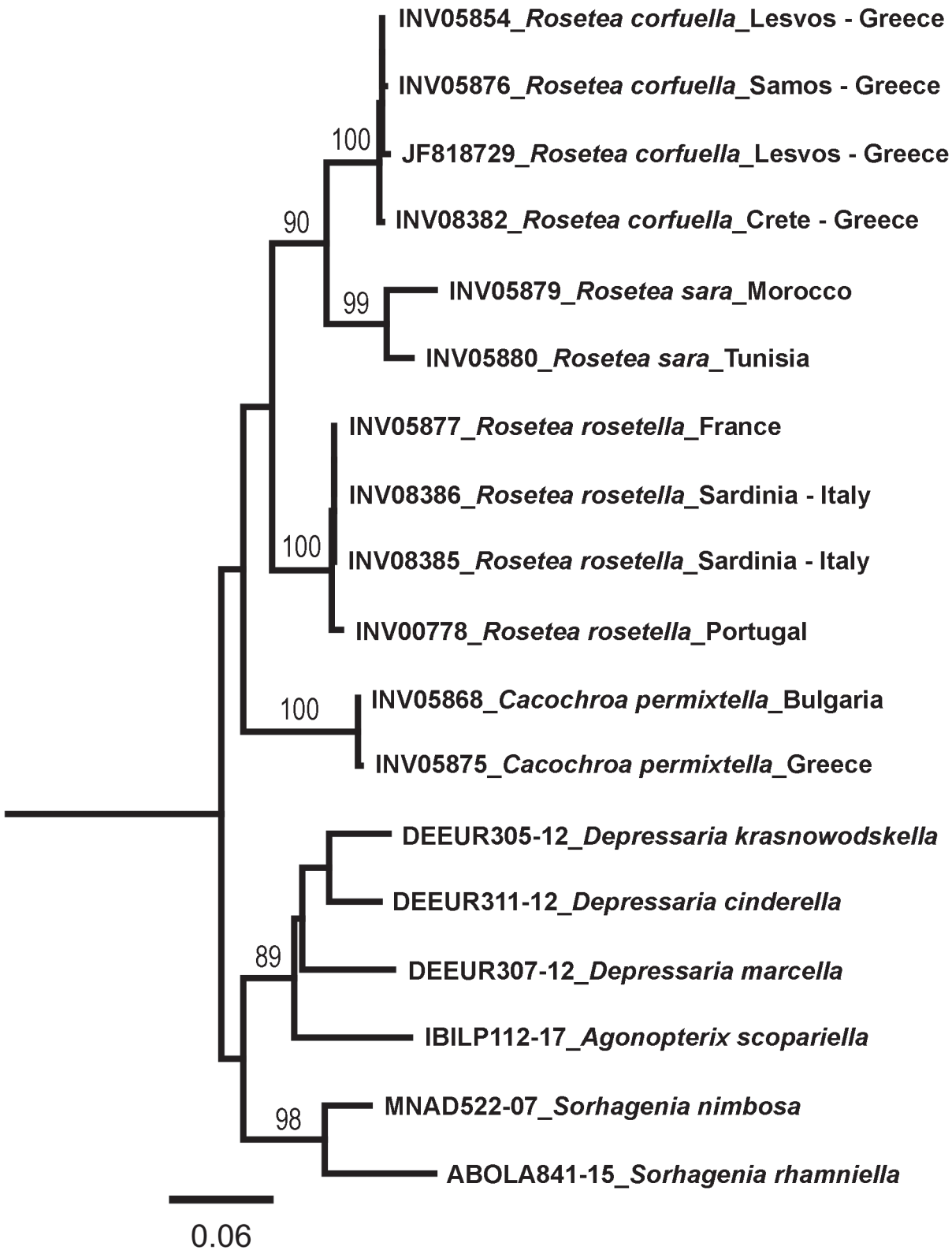

FIGURE 6. Maximum Likelihood (ML) tree of species of *Cacochroa* based on sequences of cytochrome c oxidase I gene (COI) (n = 18; 658 bp); bootstrap values (>70%) indicated at nodes.

***Rosetea sara* Corley & Ferreira sp. nov.**
(Figs 1E–F, 3C–D, 4D)

Material examined: Holotype male: Morocco, High Atlas, Ouirgane, 10 km NW, 31.213° N, 8.073° W, 30.v.–3.vi.2015, 1050 m, C. Hviid, O. Karsholt & K. Larsen leg., B. Goodey gen prep. 5405 (ZMUC). DNA barcode: INV05879.

Paratypes: **Morocco:** 1 ♂, same data as holotype but M. Corley gen. prep. 5375 (ZMUC).

High Atlas, Ourika Valley, *Phillyrea angustifolia*, I.1966, K.A. Spencer leg., 1 ♀, genitalia mounted with specimen (NHMUK).

Tunisia: Ain Draham area, 5−18.v.1988, O. Karsholt leg., 1 ♀, M. Corley gen. prep. 5374 (ZMUC); ♂same data, B. Goodey gen prep 5406. DNA barcode: INV05880.

Diagnosis. Externally *R. sara* differs from other members of the subgenus in the straighter costa of forewing with more ochreous coloration; male genitalia have shorter juxta lobes and aedeagus not recurved at base; female genitalia with short anterior apophysis; signum with longer basal part than in *corfuella* but overall less bent.

Description (Figs 1E–F). Wingspan 13−14.5 mm. Frons creamy white, vertex creamy grey; labial palpus segment 3 one-third length of segment 2, segment 2 whitish on inner side, outer side light grey with some fuscous scales at base, in middle and at apex, segment 3 whitish, without blackish apex; antenna light grey-fuscous, intersegmental divisions dark fuscous, a dark fuscous spot on each segment on upper side. Thorax ochreous-grey. Forewing costa not or hardly bulging; dull ochreous, lightly overlaid with grey scales, mainly in costal half; two black dots at one-third and another at end of cell; black dots between veins in outer part of costa and along termen; cilia greyish ochreous. Hindwing grey.

Variation: Two Tunisian specimens examined have narrower forewings with straighter costa and coloration more grey.

Male genitalia (Figs 3C–D). Valva widening from base, sclerotised hook at apex of costal margin tightly curved, small, process at ventral apex digitate, tapering, harpe ending in curved digitate process exceeding posterior margin of valva; juxta lobes straight, not or hardly exceeding posterior end of tegumen; aedeagus slightly angled at about one-third, base not recurved, a mass of small cornuti present, a single large cornutus and a small external thorn at apex.

TABLE 2. Mean (below diagonal) and standard deviation (above diagonal) sequence divergence (uncorrected p-distances) at the 658 bp DNA barcoding fragment of cytochrome c oxidase I (COI) among pairs of species of *Cacochroa sensu lato* and outgroup species. Mean (Div) and standard deviation (SE) sequence divergence (uncorrected p-distances) within species.

	R. corfuella	R. rosetella	R. sara	C. permixtella	D. marcella	D. cinderella	D. krasnowodskella	A. scopariella	S. nimbosa	S. rhamniella	Div	SE
R. corfuella		0.9%	0.8%	1.1%	1.0%	1.1%	1.0%	1.0%	1.1%	1.1%	0.4%	0.2%
R. rosetella	7.0%		1.0%	1.0%	1.1%	1.1%	1.0%	1.1%	1.1%	1.1%	0.3%	0.1%
R. sara	6.2%	7.2%		1.1%	1.1%	1.0%	1.0%	1.0%	1.1%	1.1%	3.5%	0.7%
C. permixtella	9.6%	8.1%	9.7%		1.0%	1.1%	1.1%	1.2%	1.0%	1.1%	0.2%	0.2%
D. marcella	9.7%	9.6%	10.3%	9.3%		0.9%	0.9%	1.0%	1.0%	1.1%	NA	NA
D. cinderella	9.2%	9.0%	9.0%	9.5%	6.1%		0.8%	0.9%	1.1%	1.2%	NA	NA
D. krasnowodskella	8.9%	8.2%	9.7%	9.8%	6.5%	4.7%		0.9%	1.1%	1.1%	NA	NA
A. scopariella	9.2%	9.3%	9.5%	11.1%	7.8%	7.4%	6.4%		1.0%	1.1%	NA	NA
S. nimbosa	10.1%	9.7%	10.5%	8.2%	8.2%	9.7%	9.3%	8.4%		0.9%	NA	NA
S. rhamniella	10.2%	9.7%	10.0%	9.4%	10.5%	10.8%	10.0%	9.0%	5.9%		NA	NA

Female genitalia (Fig. 4D). Posterior apophysis four times as long as anterior apophysis; ostium surrounded by sclerotised semicircular thickening, associated with tongue-shaped flap with terminal setae; antrum with two short longitudinal scelerotisations, ductus bursae very short, corpus bursae with posterior bulge at origin of ductus spermathecae, anteriorly narrowly pear-shaped; cornutus large, thorn-like with spinous teeth on one margin.

Biology. Specimens have been taken in May and beginning of June. Kenneth Spencer was a specialist in Agromyzidae (dipterous leaf-miners). K. A. Spencer's specimen label gives the host-plant as *Phillyrea angustifolia*. It appears that he reared this species through to adult from the mining stage.

Distribution (Fig. 5). The species is known only from valleys in the High Atlas Mountains of Morocco and Ain Draham in Tunisia.

Etymology. *R. sara* is named after M.C.'s great niece, Sara, born in the year this revision was started, daughter of Khaled, a Berber from the same district as the holotype.

Molecular results: All samples amplified the COI barcoding fragment. The final COI dataset consisted of 12 sequences (658 bp long) from 4 *Cacochroa sensu lato* species and 6 outgroup sequences (Fig. 6). All specimens exhibited distinct COI haplotypes. Within the *Cacochroa sensu lato* COI dataset, no indels and no stop codons were observed, and there were 102 mutations and 88 parsimony informative sites.

The most appropriate model for the COI dataset was GTR+G. Tree topologies from ML approach exhibit high bootstrap values (≥0.98%) to all *Cacochroa sensu lato* species (Fig. 6).

Within *Rosetea* the maximum pairwise divergence was obtained between *R. rosetella* and *R. sara* (p-distance=7.2%) and the minimum pairwise divergence (6.2%) was observed between *R. sara* and *R. corfuella* (Table 2). Minimum pairwise divergence between a *Rosetea* species and *Cacochroa* species was 8.1% between *R. rosetella* and *C. permixtella* and the maximum observed between *R. sara* and *C. permixtella* (p-distance=9.7%). The *Depressaria* species used as outgroups exhibited approximately 4.7–6.5% sequence divergence. The mean sequence divergence (uncorrected p-distance) within *Cacochroa sensu lato* species pair is low (<0.5%) with exception of the North African species, *R. sara*, (3.5%), nevertheless is approximately half of the mean sequence divergence observed in the four species.

Discussion

The systematic placement of *Cacochroa* has gradually changed since it was described in Gelechiidae in 1870. During the 20th century the number of families in the superfamily Gelechioidea proliferated. For most of the second half of the century, *Cacochroa* was placed in Oecophoridae, usually in the subfamily Cryptolechiinae or tribe Cryptolechiini or even tribe Cacochroini, but by the end of the century new studies resulted in the tribe or subfamily being tossed from family to family. Minet (1990) recognised a greatly expanded Elachistidae: Cryptolechiinae was moved there from Oecophoridae. This was not universally accepted and the genus was still in Oecophoridae in Vives (1996). In the 21st century successive studies using DNA markers continued to revise the position of the various Gelechioid groups. The work of Nieukerken *et al.* (2011) placed Cryptolechiinae in Ethmiidae, which along with the Depressariidae was released from Elachistidae. For the Gelechioidea this work was soon superseded by a new classification (Heikkila *et al*. 2013) in which Depressariidae included the subfamilies Cryptolechiinae and Ethmiinae. It remains to be seen whether this is its last resting place. In most classifications, *Cacochroa* is treated as closely related to *Orophia* Hübner, 1825, e.g. Tokár *et al*. (2005).

Based solely on external features recognition of two separate genera could not be justified. These include labial palpi, antennae, forewing shape, markings and coloration which are very similar in the two genera, and wing venation is identical. They also share one male genitalia feature, the recurved base of the aedeagus, although this is not present in *R. sara*. This feature is also shared with the related genus *Orophia* Hübner, 1825. Regarding molecular results, while the data indicates *C. permixtella* as the more distinct species from the group, it is debatable if it supports clearly the existence of two distinct genera. However, all arguments for maintaining a single genus are overturned by the remarkable difference in male genitalia between *Cacochroa* (Fig. 2) and *Rosetea* (Fig. 3). When M.C. first dissected a male of *C. permixtella*, he considered the possibility that an abdomen belonging to another superfamily had been substituted onto the specimen concerned. Female genitalia (Figs. 4A and 4B–D) are also markedly different especially in the structure of the signum.

The Moroccan and Tunisian specimens of *R. sara* have a 3.5% DNA barcode sequence divergence and there

are also small differences in the external appearance, notably the narrower forewings and greater amount of grey coloration of the forewings in Tunisian specimens. These differences suggest that the populations could be treated as separate species, but we have not done so for several reasons. Although *Cacochroa sensu lato* has a characteristic wing shape, the development of the hump on the forewing costa does show some variation between individuals and is occasionally not pronounced as in some of the examples of *R. rosetella* on the website Pathpiva. The samples are very few, which may therefore not show the full variation within each population, male genitalia are indistinguishable and the female genitalia preparation from the Moroccan population is mounted in an unusual way, probably in an unusual medium, which precludes satisfactory examination. A 3.5% divergence between two populations would be a strong argument for species separation in many groups, but is not large compared with other species differences in *Cacochroa sensu lato* (>6.2%). We have therefore taken a cautious approach and treat both populations as belonging to a single species.

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